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10/749,694	12/29/2003	Dimitry Gorinevsky	H0006745 US	2154

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EXAMINER

BLOOM, NATHAN J

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2624

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PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 10/749,694	Applicant(s) GORINEVSKY, DIMITRY	
	Examiner NATHAN BLOOM	Art Unit 2624	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 May 2008.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-20 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Applicants' response to the last Office Action, filed on May 20th, 2008 has been entered and made of record.

Response to Arguments

1. Applicant's arguments filed 05/20/2008 have been fully considered but they are not persuasive. Please see the discussion below.
2. In response to applicant's argument on pages 12-13 of the *Remarks* that the cited prior art does not teach the deblurring of a video image. As per the rejection below Biemond, Owens, and Lavenier have taught the system and method for iteratively deblurring an image using a systolic array processor. Given that a video is merely a sequence of still images, and that Biemond, Owens, and Lavenier have taught that the processing of blurred still images it would have been obvious to one of ordinary skill in the art at the time of the invention to input a series of related blurred images (video) into the system to deblur a series of image data (video) with a reasonable expectation for success. Furthermore, Okuda has taught the use of parallel processing to process image data in real-time (real-time means no delay). Thus, given the teachings of Okuda one of ordinary skill in the art at the time of the invention would have combined the teachings of teachings of Biemond, Owens, and Lavenier with Okuda by adapting the parallel processing system taught by Biemond, Owens, and Lavenier to process the image data in real-time as taught by Okuda to correct a blurred series of images (video) at a high rate.

3. In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, applicant has made a broad statement that none of the rejections for the 20 claims of this application have a proper motivation for combination. Applicant has not specifically addressed what the issues with each of the proposed combinations and motivations are, thus the examiner cannot address the issues since they have not been clearly presented.

4. In response to applicant's argument on page 14 that the limitation of claim 1 that requires the processing blocks to exchange data only with adjacent processing blocks has not been addressed. Systolic array as depicted in Figure 4 of Owens (as stated in previous rejection) are connected only to a predetermined number (4) of adjacent blocks.

5. In response to applicant's argument on page 15 that the limitation of claim 2 that requires the planes to comprise blurred video image, blurred video image prediction error, and a past deblurred video image are not disclosed by the cited prior art. Examiner stated in the rejection of instant claims 2 that f_k was the past blurred image, $g-H f_k$ was the prediction error, and leaving the final component of the equation to be (f_{k+1}) the current blurred image. However, it was not

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clearly stated since f_k was defined as the past, but it was believed to be clear since f_k was stated as the past that f_{k+1} is the current blurred video image.

6. In response to applicant's argument on pages 18 that the algorithm of claim 3 was not disclosed by the cited prior art. As cited in the previous office action Biemond has disclosed an algorithm containing the u , y , and H components and teaches the existence of and solution to the regularization error, but does not site the solution that is claimed in the algorithm provided by claim 3 (" $S*u$ " component is the solution to the regularization error in claim 3). However, Gorinevsky has taught the solution to the regularization error using $S*u$ and K to solved the regularization error (improve spatial response). It would have been obvious to one of ordinary skill in the art to modify the regularization solution of Biemond with the teachings of (alternative solution to regularization error) Gorinevsky to improve the response of the algorithm. Thus the combination of Biemond and Gorinevsky has taught the algorithm of claim 3.

7. In response to applicant's argument on page 20 that the prior art does not disclose the limitation of claims 10 and 17 of storing the H , K , and S values into the processing logic blocks of the array. As per the rejection as evidenced by Owens and Lavenier the loading of information for the purpose of processing data in the array was known (Owens 2nd paragraph of page 338). Furthermore, Lavenier in section 5.2 teaches the storing of weights for multiplication in the processing units, but Owens, Lavenier, and Biemond did not specifically teach the loading of H , K , and S into the processing units. This is because neither Owens nor Lavenier taught the method performed by Biemond, but the combination of Biemond, Owens, and Lavenier has

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taught the iterative deblurring of image data on a systolic array. Furthermore, the combination of Biemond, Owens, Lavenier, and Gorinevsky has taught the iterative deblurring of image data on a systolic array with an enhanced regularization error correction. Given that Owens and Lavenier have clearly taught that the storage of coefficients for performing the operations of algorithms is a necessary part of the operation of data on a systolic array, and Biemond and Gorinevsky have taught a particular iterative image deblurring algorithm with arrays of coefficients for operating on the image data. Clearly one of ordinary skill in the art at the time of the invention would have recognized that the implementation of an algorithm on the systolic array as suggested by the rejection of these claims would require the use of the necessary arrays of coefficients as was taught by both Owens and Lavenier.

8. In response to applicant's argument on page 21 (4th paragraph) that Dowski has only taught the processing of a single channel. Biemond in view of Gorinevsky has taught the deblurring of an image with at least one color channel (does not specify whether image is color or grey scale), and Dowski has taught the deblurring of a color image by processing each channel with the same algorithm. Given the teachings of Dowski, one of ordinary skill in the art would have had a reasonable expectation of success in processing a color image using the method taught by Biemond in view of Gorinevsky by applying the single color channel process to each channel as has been taught by Dowski. Examiner is confused by the applicant's presented argument since it seems that the applicant is arguing that Dowski only teaches the processing of a single channel, but Dowski is instead teaching and being used to teach the processing of multiple channels using a single channel process.

Response to Amendment

9. The 35 USC 112 2nd paragraph rejection of claims 1, 7, and 14 has been withdrawn in response to applicant's amendment, and the argument on pages 8-9 of the submitted reply.

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

11. Claims 1-2, 5-8, 12-15, and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biemond in further view of Owens ("Computer Vision on the MGAP") and Lavenier ("Advanced Systolic Design"), and in further view of Okuda (US 6493467).

Instant claim 1: A method of deblurring a video image, comprising the steps of:

downloading a blurred video image comprising a plurality of pixels into a systolic array processor, said systolic array processor comprising an array of processing logic blocks in parallel such that groups of said plurality of pixels arrive in each respective processing logic block of said array of processing logic blocks respectively; [*Biemond describes an iterative method for image deblurring performed by a computing system used to process the image, but does not explicitly teach the downloading of a video image, the use of a systolic array processor to*

perform the deblurring method Owens teaches the downloading of an image for further processing in paragraph 2 of the "Introduction" section. Owens further teaches the use of a systolic array of interconnected logic blocks (Digit Processors) for the parallel processing of images (deblurring is image processing) in sections 2.1 and 3.1. Furthermore, figure 4 of Owens shows the adjacent interconnections of the processing array in which the plurality of pixels are communicated to their respective Digit Processors (processing logic blocks).

It would have been obvious to one of ordinary skill in the art at the time of the invention to use the known systolic array disclosed by Owens with the known iterative image deblurring method disclosed by Biemond according to the teachings of Lavenier, that teach the use of iterative methods on a systolic array (section 5. 2). Thus, the combination provides the predictable result of iterative image deblurring according to the known method of Biemond using the known device of a systolic array as disclosed by Owens and Lavenier. Also, neither Owens, nor Lavenier, nor Biemond discuss the processing of video images. However, Examiner takes official notice that it was notoriously well known to one of the ordinary skill in the art to process video frames using still image methods. Therefore, one of ordinary skill in the art at the time of the invention would have modified the system and method of operating on still images as taught by Biemond in view of Owens and Lavenier with the knowledge of one of ordinary skill in the art to perform the predictable result of processing a video frame by frame. Thus the method taught by Biemond in view of Owens and Lavenier for deblurring an image is also applicable to the processing of a sequence of images (video).];

sequentially exchanging data between said array of processing logic blocks by
interconnecting each processing logic block with only a predefined number of the processing

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logic blocks adjacent thereto; *[This is the definition of array processing, which is the processing and communication of data by a grid of processing units that are interconnected with adjacent processing units. For an example see figure 4 of Owens.]*

providing an iterative update of said blurred video image by storing each pixel of said plurality of pixels in three planes within said systolic array processor wherein said iterative update occurs within said blurred video image video frame update rate; and *[Biernacki teaches the iterative deblurring method in the section entitled "Iterative Solutions" beginning on page 865 using three sets of data (f_{k+1} , f_k , and $g-Hf_g$) each dependent on the particular pixel data they correspond to (thus each set is an image "plane" because it varies with x and y , where x and y are the pixel indices). The method and system disclosed by Biernacki in view of Owens and Lavenier correct the image at some rate but do not specify that it is at the frame rate of the video ("real-time"). However, Okada teaches a parallel processing system in column 3 lines 29-34 and column 97 lines 8-13 that performs real-time processing on image data by utilizing a parallel processing system. Thus, as is evidenced by Okada one of ordinary skill in the art at the time of the invention would have expected the reduction in image processing time when utilizing a parallel processing system, and would have desired the image processing to occur in real-time. Therefore, it would have been obvious to one of ordinary skill in the art to modify the parallel processing system and method of Biernacki, Owens, and Lavenier with the teachings of Okada to process image data in real-time. Furthermore, real-time image processing allows for real-time video processing since a video is a sequence of single images. (Also, see discussion of this claim in the above "Response to Arguments" section.)]*

uploading a deblurred video image [*Owens and Biemond do not explicitly teach the uploading of the blurred image. However, Examiner takes official notice that the uploading of the deblurred (processed) image is notoriously well known in the art. Since the purpose of deblurring the image is to produce a deblurred image for display or further processing, and thus would have been obvious to one of ordinary skill in the art to modify the teachings of Owens, Biemond, and Lavenier to store or upload the processed image for retrieval or display*].

Instant claim 2: The method of claim 1, wherein said three planes comprises said blurred video image, a blurred video image prediction error, and a past deblurred video image, wherein said array of processing logic blocks provide an iterative update of said blurred video image by (i) providing feedback of said blurred image prediction error using said deblurred video image and (ii) providing feedback of said past deblurred image estimate. [*Owens and Lavenier disclose the implementation of an iterative method on a systolic array as is discussed in rejection of instant claim 1. Biemond teaches an iterative method for deblurring images in pages 865-868 under the section titled "C. Iterative Solutions" using error feedback and past deblurred image estimate feedback (f_{k+1} is the blurred image, f_k is the past iteration of the deblurred image, and $g-Hf_k$ is the prediction error). In particular, see equations 56 and 57 on page 865. Furthermore, as is evidenced by both Lavenier in section 5. 2the implementation of iterative algorithms on a processing array was well known to one of ordinary skill in the art.*]

Instant claim 5: The method of claim 1, wherein said each group of said groups of said plurality of pixels processor groups pixel in groups that comprises at least one pixel. [*Biemond in view of*

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Owens and Lavenier as applied to claim 1 teach the deblurring of an image using a systolic processor array. Owens teaches the implementation of image processing methods using systolic array processors for image processing and in the final line of the 2nd paragraph on page 338 that at least one pixel is operated on per processor. Thus, as is taught by Owens the pixels are grouped into groups of pixels such that at least one pixel is operated on per processor.]

Instant claim 6: The method of claim 5, wherein said groups of pixels comprises a group selected from 2 by 2 pixels, 3 by 3 pixels, and 4 by 4 pixels. *[Filtering and image processing methods such as deblurring are done locally by operating on groups of adjacent pixels. Owens discloses an example of such a grouping in section 3.1 on page 338 wherein Owens disclosed the use of 3x3 masks applied to the image and hence it was known to group and process pixels in a processing array.]*

Instant claims 7-8, 12-15, and 19-20 claim the corresponding device that performs the method of instant claims 1-2 and 5-6. As per the rejection of instant claims 1-2 and 5-6 the method has been disclosed by Bimond in view of Owens and Lavenier. Furthermore, the implementation of a systolic array device for image processing has been disclosed by Owens and Lavenier.

12. Claims 3, 9-10, and 16-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bimond in view of Owens, Lavenier, and Okuda as applied to claims 1-2 and 5 above, and in further view of Gorinevsky (“Optimization-based Tuning of Low-bandwidth Control in Spatially Distributed Systems”).

Instant claim 3: The method of claim 2, wherein said iterative update is implemented in said each processing logic block by $u(n+1) \equiv u(n) - K * (H * u(n) - y_b) - S * u(n)$ [Bimond: see equations 56 and 57 on page 865, $u(n+1)=f(k+1)$, $u(n)=f(k)$, $g=y_b$, $K=B$, and $H=H$] where u comprises an ideal undistorted image, m and n comprise column and row indices of an image pixel element, $y_b(m,n)$ comprises an observed blurred image, $*$ denotes a 2-D convolution, K comprises a feedback update operator with a convolution kernel $k(m,n)$ and S comprises a smoothing operator with a convolution kernel $s(m,n)$ [Bimond identifies the existence of regularization error and discloses a solution of the regularization error in section 5 which begins on page 868. The term $S * u(n)$ as defined by applicant was known to one of ordinary skill in the art as a solution to the regularization problem. Bimond does not teach the regularization method shown by applicant. However, Gorinevsky in sections 1 and 3 teaches a filter that improves the spatial response (reduces regularization error) of the system. It would have been obvious to one of ordinary skill in the art to substitute the regularization method as taught by Gorinevsky for the regularization method taught by Bimond with a reasonable expectation of success while maintaining or improving the spatial response (reduction of regularization error) provided by the method taught by Bimond. Furthermore, in the same sections of Gorinevsky the use of the term K has also been disclosed.].

Instant claims 9 and 16 claim the device corresponding to the method of instant claim 3. As per rejection of instant claim 3 the device has been disclosed.

Instant claims 10 and 17: The device of claim 9 [*and 16*], wherein the operators H, K, and S are preloaded in each of the array processing logic blocks. [*Owens and Lavenier do not explicitly teach the preloading of the information into each processing logic block of the array. However, as is evidenced by Owens in the 2nd paragraph of page 338 the addition, subtraction, multiplication, etc. are preformed on the received pixel data. In order to perform these operations the values intended to be used in these operations must be stored in the processing elements. Furthermore, as per the disclosure of Lavenier in section 5.2 the weights of matrix W are stored in the processing units so that they can be used to multiply the values of the input (X). Thus it is clear from this disclosure that known constants are stored in the processing units (logic blocks) in order to perform the predetermined operations*]

13. Claims 4, 11, and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biemond in view of Owens, Lavenier, Gorinevsky and Okuda as applied to claims 3, 9-10, and 16-17 in further view of Dowski (US 2003/0169944).

The method of instant claim 4 is a modification of the method of instant claim 3 wherein the deblurring is performed on each color space separately. Biemond discusses image processing, but does not go into the particulars of color space processing. However, as is evidenced by Dowski in paragraph 0018 the method of dividing an image into its color spaces and then deblurring each of the color spaces was known to one of ordinary skill in the art. The teaching of Dowski shows that one of ordinary skill in the art knew how to apply image-filtering processes

such as deblurring to a color image by breaking it down into color channels and processing each one separately. Given that Biemond teaches the deblurring of at least a grayscale image and that Dowski teaches the application of a deblurring process to each of the color channels individually (i.e. treat each channel independently). Then it would have been obvious to one of ordinary skill in the art to combine the teachings of Dowski with Biemond to perform the deblurring technique as taught by Biemond on each channel of a color image and yield the expected result of a deblurred color image.

Instant claims 11 and 18 claim the device corresponding to the method of claim 4. As per the rejection of instant claim 4 the device has been disclosed.

Conclusion

14. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event,

however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Contact Information

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nathan Bloom whose telephone number is 571-272-9321. The examiner can normally be reached on Monday through Friday from 8:30 am to 5:00 pm (EST).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mehta Bhavesh, can be reached on 571-272-7453. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/Brian Q Le/

Examiner, Art Unit 2624